Kentucky Geological Survey
UNIVERSITY OF KENTUCKY

Kentucky Geology

Earth Resources—Our Common Wealth

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Kentucky Geological Survey
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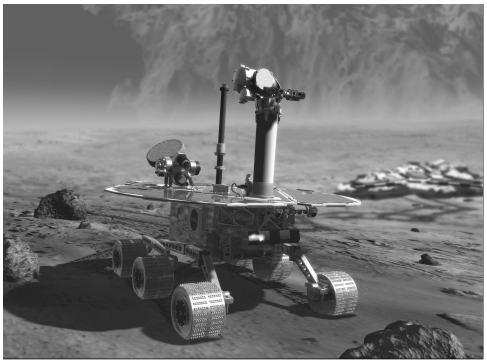
Our mission is to increase knowledge and understanding of the mineral, energy, and water resources, geologic hazards, and geology of Kentucky for the benefit of the Commonwealth and Nation.

In this issue

13th annual KGS Distinguished Lecturer

Patricia Wood Dickerson honored

Where were you on July 20, 1969? If you're old enough to remember, you were probably watching your TV in awe as humans first walked on the Moon. These days, NASA's strategy is to send vehicles to explore the surface of other worlds and send images back to Earth. By 2013, robotics missions may be sent to Mars to collect mineral, soil, and other samples.



The Mars Exploration Rover. Illustration courtesy of NASA.

Patricia Wood Dickerson is part of this effort. A geoscientist with Lockheed Martin at NASA–Johnson Space Center in Houston, Tex., Dickerson instructs space shuttle and international space station (ISS) crews in tectonics, terrestrial analogues for planetary features, and archaeology; she also assists in developing the earth sciences curriculum for ISS crews. She spoke about her work in her talk, "Springs, Sediments, and Streaks—Terrestrial Analogues on Earth's Moon and Mars," on April 2. The lecture was the latest in the Kentucky Geological Survey's Distinguished Lecture Series, which was established in 1988 to bring in outstanding researchers and scholars to speak on important geoscience topics.

Patricia Wood Dickerson

In her teaching as a geoscientist, she said it has been most gratifying to be told by the

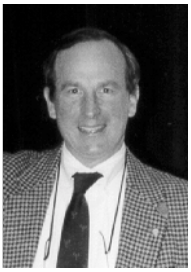
(Continued on page 3)

Toward a new national energy policy

Will the lights go out in Kentucky?

Will Kentucky experience rolling blackouts like the ones in California? Will energy prices continue to rise? These and other questions were discussed at an Energy Forum sponsored by the Kentucky Geological Survey as part of its Geology and Public Policy Series. On March 8, **G. Warfield "Skip" Hobbs**, president of the Division of Professional Affairs of the American Association of Petroleum Geologists, gave the keynote address, "Energy Policy: Should the Public Care?" The public should indeed care, Hobbs said, because our nation faces an energy crisis caused by complacency and addiction to cheap energy over the past 15 years. Hobbs said, "This era is coming to an end not with a whimper, but a gigantic thud, as energy prices this winter have so bluntly demonstrated."

We have become dangerously dependent upon crude oil imports from politically unstable countries. Furthermore, we must now compete with developing countries such as China and India for access to crude oil sold in international markets and for exploration and development projects in the Middle East.



"Skip" Hobbs

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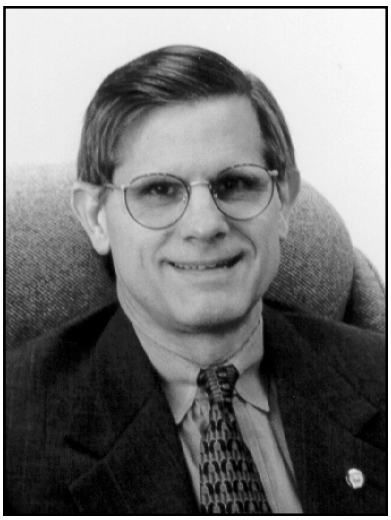
Director's Desk

The year 2001 has seen upheavals related to energy in the United States. Energy price and supply, environmental impacts, trade deficits, and dependence on foreign oil have been major topics of debate in the news. California has experienced rolling blackouts and a crisis in its electrical energy supply. The nation has witnessed large increases in the price of gasoline, heating oil, and natural gas.

In Kentucky, the price of gasoline and natural gas has recently increased dramatically. We are fortunate, however, to have some of the lowest electricity rates in the nation, because 95 percent of our electricity is generated from coal-fired power plants. Only two other states have lower electricity rates than Kentucky.

As an energy-producing state, Kentucky generates billions of dollars through the production of these vital resources, and also through the sale of electrical energy within the state as well as outside of the state. Kentucky's energy resources include significant amounts of coal, natural gas, oil, and tar sands. These resources have been produced for more than a century, and depletion has taken a toll. Research must continue if new prospects are to be identified for development in the future. New and exciting geologic prospects are being investigated in the Rome Trough and Rough Creek Graben. At KGS we are assisting private-sector geologists who are exploring for and developing these vital energy resources by publishing the results of our research; providing public access to oil, gas, and coal data and maps; and making well samples and cores available at KGS.



As Kentuckians have become more concerned about the environmental impact of increased energy production, our involvement in environmental geology has increased. Although energy resources are vital for our economic well-being and quality of life, preserving our environment is equally important. Geology plays a tremendous role in society in finding and producing energy, as well as protecting the environment. As Kentucky's twelfth state geologist, I, like my predecessors, appreciate the importance of energy resources. What is different today is an equal emphasis on the importance of a clean and safe environment. ❖

James C. Cobb

Juanita Smith recognized

Forty years of dedicated service

Congratulations to **Juanita Smith,** the office assistant at the **Henderson** field office, who recently celebrated her 40th anniversary with the Survey. Juanita first joined the KGS family on February 15, 1960. Recruited by the late **Wallace Hagan,** then the State Geologist, Juanita jokes that she came to the Kentucky Geological Survey "by covered wagon." At that time the field office was housed in the Henderson Armory. One day when a pipe burst, Juanita spent a full Saturday hanging up geophysical logs to dry. The office was later moved to the campus of the Henderson Community College, where it remained until moving to its present location on North Main Street in 1966.

State Geologist Jim Cobb presents Juanita Smith with a necklace commemorating her 40 years with KGS.

Juanita is now shepherding her fourth generation of geologists. When she started, there were a mere 250 petroleum records on file. Now Juanita manages 60,000 records, which are used by the public and researchers.

Juanita enjoys working with the public and is most often the voice the public hears when contacting the office. She also enjoys gardening and her great-grandchild. Juanita says, "My years with the Kentucky Geological Survey have been enjoyable and very rewarding. I had 5 years with Ashland Oil (1946–1951), which started my love for oil and gas work. I have learned so much over the years due to the many good colleagues."

Thank you, Juanita, for your continued service for the people of Kentucky. ❖

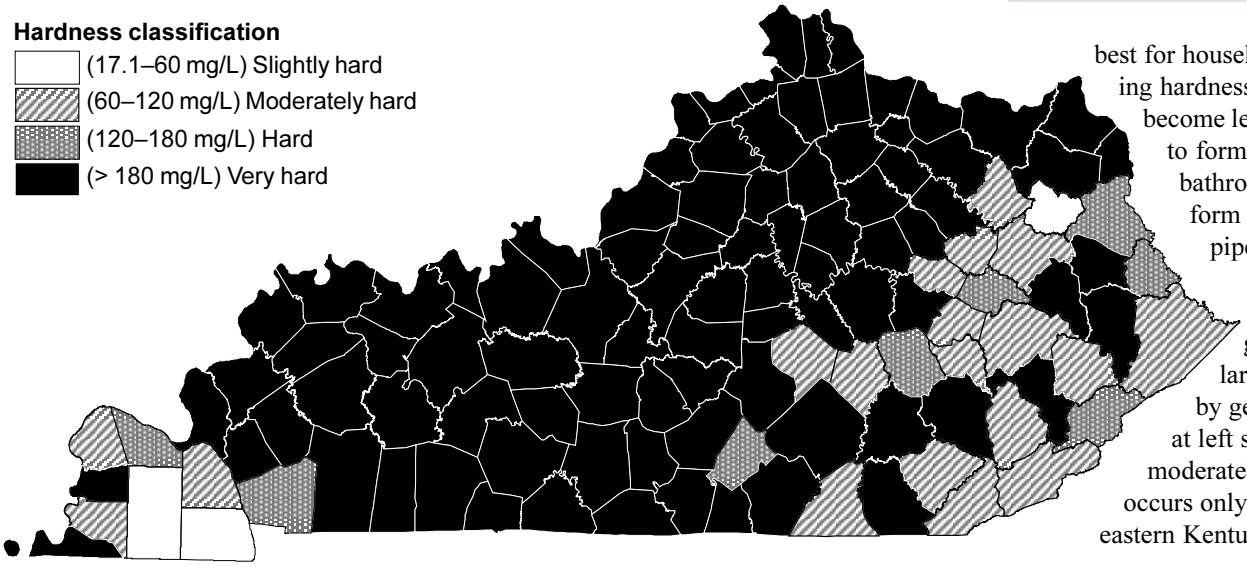
Ground water, produced from wells and springs throughout the Commonwealth, is a valuable resource that is vital to our economy and the health and well-being of our citizens. More than 25 percent of the residents of Kentucky depend on ground water for household use, and more than 226 million gallons of ground water are consumed daily by individuals, municipalities, utilities, businesses, and farms. Ground-water quality and its suitability for various uses must be known so that responsible decisions can be made regarding resource management, water-development policy, pollution prevention, and ground-water protection.

In 1998, the Kentucky Interagency Groundwater Monitoring Network was established to collect ground-water data, characterize ground-water quality, and distribute the information to interested organizations and individuals. The steps in the process are:

- Scientists collect water samples from wells and springs and submit them to a qualified laboratory for analysis. Samples may be collected specifically to investigate ground water throughout the state, as is done by the Kentucky Division of Water, or they may be collected by other agencies, organizations, university researchers, or the Kentucky Geological Survey for other purposes.
- All available ground-water information is collected and stored in the Kentucky Ground-Water Data Repository, which is housed at the Kentucky Geological Survey. The Kentucky Interagency Groundwater Monitoring Network uses this database to analyze ground-water quality and prepare reports.
- The Interagency Technical Advisory Committee on Groundwater, composed of representatives from State and Federal organizations, as well as university researchers, helps determine which ground-water constituents are examined and how the results are presented.
- KGS researchers, both independently and in cooperation with the Kentucky Division of Water, prepare maps, statistical summaries, and reports about ground-water quality for the entire state and for specific areas of interest. The maps, summaries, and reports are periodically updated as new information comes to the repository.

Sample products of the Kentucky Interagency Groundwater Monitoring Network

Maps of hardness and pH illustrate some of the products of the network. Water hardness is a measure of the amount of dissolved calcium and magnesium. "Soft" water has little calcium and magnesium and is best for household use. Increasing hardness causes soaps to become less effective, scum to form in kitchens and bathrooms, and scale to form in water heaters, pipes, and cooking utensils. Hardness in ground water is largely controlled by geology. The map at left shows that soft to moderately hard water occurs only sporadically in eastern Kentucky and in the



The Kentucky Ground-Water Data Repository

The Kentucky Ground-Water Data Repository was established in 1990 to archive and distribute ground-water data collected by State agencies, other organizations, and independent researchers. Prior to this time there was no central, readily accessible source of ground-water information.

The repository collects and stores water well locations, well construction descriptions, water-quality reports, spring locations and discharge rates, and results of dye traces, as well as ground-water maps and other publications. The repository also provides this information to anyone who is interested in Kentucky ground water, wells, or springs. Currently, the repository contains information for more than 52,000 water wells, 4,000 springs, 350 dye traces, and 45,000 water-quality analyses.

For more information about the Kentucky Ground-Water Data Repository, contact **Bart Davidson** at 859.257.5500 or e-mail bdavidson@kgs.mm.uky.edu. ❖

Jackson Purchase Region—where carbonate bedrock is generally absent. In regions underlain by limestone, and in the Western Kentucky Coal Field where slightly acidic ground water dissolves any carbonate present, untreated ground water is hard to very hard. Average hardness values are shown for each county, so general trends are emphasized rather than values at specific sites.

The parameter "pH" is a measure of the acidity of water. A pH of 7 is neutral for pure water at normal temperatures, and values between 6.5 and 8.5 are suitable for household use. Water having lower pH values can corrode pipes and plumbing fixtures, whereas water having higher pH values can cause calcium carbonate scale to form. The map below shows that most wells and springs have pH values between 6.5 and 8.5, but pH varies significantly in the eastern and western Kentucky coal regions, and in the Jackson Purchase. The different rock types in these areas readily explain these patterns. In the Bluegrass and Pennyroyal Regions, carbonate bedrock acts as a buffer, and keeps pH at near-neutral values, whereas the relative absence of limestone in the coal fields and the Jackson Purchase Region permits a wider range of pH values. By showing pH values at each individual well or spring, this map also indicates the variability that can be expected in different parts of Kentucky.

Similar maps are being prepared for major and minor constituents in water as well as for pesticides, nutrients, and metals. Maps of nitrate and fluoride in ground water can be seen on the KGS Web site at www.uky.edu/KGS/pubs/publications.htm. Other maps will be posted as soon as they are completed.

Summary

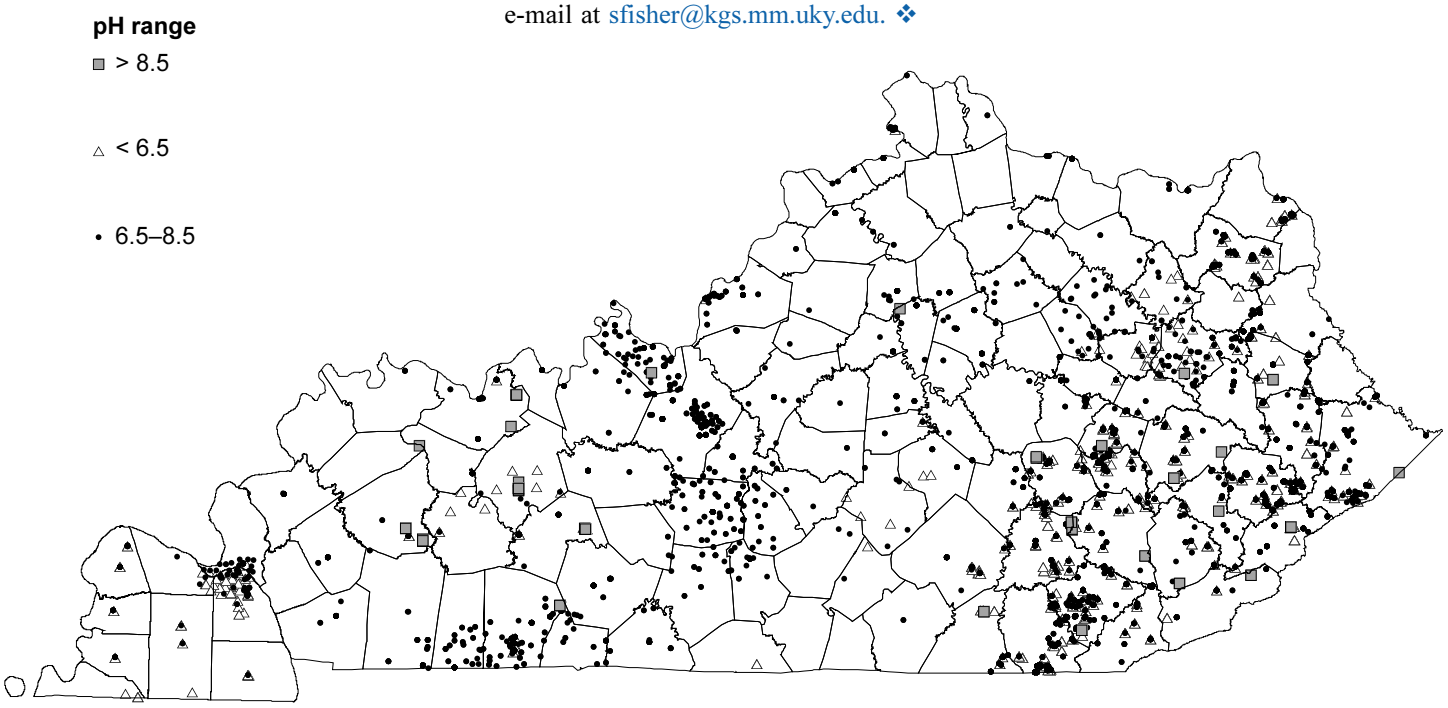
Ground water accounts for more than 30 percent of the public and private water supplies in the Commonwealth, and as much as 90 percent of all rural domestic supplies. Furthermore, ground water is the major source of water in Kentucky's rivers and streams, and is particularly important during periods of drought. To intelligently manage and protect this precious resource, current ground-water quality must be assessed and evaluated. Only when the quality of ground water and its suitability for various uses are known can informed decisions be made about developing community and private water supplies, addressing resource allocation issues, setting boundaries on wellhead protection areas, and recognizing ground-water degradation.

For additional information, visit the network's Web site at www.uky.edu/KGS/water/gnet/gnet.htm or contact **Steve Fisher** at 859.257.5500 or by e-mail at sfisher@kgs.mm.uky.edu. ❖

Interagency Technical Advisory Committee on Ground Water

Representatives from the following organizations advise and assist the Kentucky Interagency Groundwater Monitoring Network:

- Kentucky Department for Environmental Protection
- Kentucky Department for Natural Resources
- Kentucky Department for Surface Mining Reclamation and Enforcement
- Kentucky Department of Mines and Minerals
- Kentucky Division of Conservation
- Kentucky Division of Environmental Health and Community Safety
- Kentucky Division of Forestry
- Kentucky Division of Pesticides
- Kentucky Division of Waste Management
- Kentucky Division of Water
- U.S. Geological Survey
- University of Kentucky College of Agriculture
- University of Kentucky Water Resources Research Institute❖



(Will the lights go out in Kentucky, *continued from page 1)*

Although research must continue on alternative energy resources, the nation will continue to depend primarily on fossil fuels for many more decades. According to Hobbs, a new national energy policy should include greater access to public lands for drilling, streamlining of regulatory and permitting processes, and tax reform. A national energy policy that balances the interests of all stakeholders should be developed and implemented as quickly as possible.

On March 9, a panel of experts from Federal and State government agencies, academic research institutes, private industry, and an environmental organization considered two questions: If a national energy policy is formulated, what will be the implications for Kentucky? And, What is the most critical issue in developing a national energy policy?

- **Skip Hobbs** argued that we cannot take our abundant fossil fuels for granted. Also, the public must be educated about the true state of the energy industry; without public support, there can be no effective energy policy.
- **Ione Taylor** of the U.S. Geological Survey said that the current Federal administration is considering several issues while formulating a national energy policy, including expanding domestic supply, examining energy potential under public lands, and rolling back some environmental regulations.
- **Mike Sanders,** an independent oil and gas producer, said that since 1986 government policy has forced thousands of independent oil and gas companies out of business. He suggested that the ranks of skilled and knowledgeable energy workers are thin, and it will take years of sustained growth for the U.S. petroleum industry to recover and meet new energy challenges.

- **Ari Geertsema** of the Center for Applied Energy Research at the University of Kentucky said that an energy policy should be socially aware and accountable, and it should reward both commercial and scientific success. He felt that new technologies could best be developed using a team approach across traditional discipline boundaries.
- **David Drake** of East Kentucky Power Cooperative said that rising electricity prices and supply shortages on the West Coast are not unique, and similar problems are likely to occur on the Eastern Seaboard during this summer's peak season. He felt an energy policy should address market uncertainty and encourage investment to meet rapidly rising demand. It should also encourage the development of advanced clean coal technologies.
- **Tom Dorman** of the Kentucky Public Service Commission noted that although Kentucky has not deregulated its electricity market, the impact of deregulation is being felt from bordering states that have deregulated or are considering doing so. Although Kentucky has enjoyed an abundant, low-cost power supply, in large part because of coal, Dorman suggested that changes in the structure of the market may affect that price.
- **Dick Shore,** an environmental consultant, said that we need to "massively conserve." We must understand the consequences of our actions, and act in ways that have minimum impact. When we say "Not in my backyard," we must recognize that all of the Earth is our backyard. We need to think beyond merely "sustainable" to "vigorously self-renewing." ❖

(Patricia Wood Dickerson, *continued from page 1)*

Left–right: Robert Andrews, Patricia Wood Dickerson, Haluk Cetin.

astronauts she instructs, "You have changed the way I look at the world." It has also been a mutual learning process. She admires the astronauts' philosophy of learning, which she characterizes as "See it, scope it, do it!"

Dickerson emphasized that we must make the best use of equipment, people, and minds for space exploration today, because we may never have the opportunity again.

The day after her talk, Dickerson participated in a forum, with **Haluk Cetin** and **Robert Andrews,** about new technologies for water-resource assessment. Dickerson opened the forum by showing slides from space that demonstrated the fragility of water resources in diverse locations on Earth. She also discussed a field geophysical training exercise in New Mexico that she developed for astronaut candidates (see geoinfo.nmt.edu/penguins/ for more information). Cetin, a research associate at the Mid-American Remote sensing Center (MARC) and an assistant professor in the Department of Geosciences at Murray State University, discussed techniques used to identify ground-water resources south of Tucson, Ariz. Andrews, a hydrogeologist at KGS for almost 9 years, discussed his project in eastern Kentucky that is using remote-sensing and inclined-drilling techniques to locate high-yield water wells. Additional information about this project is found at www.uky.edu/KGS/water/research/bwhyield.html. ❖

Calendar of events

- **September 23–25, 2001:** The Society for Organic Petrology 18th Annual Meeting, Westchase Hilton and Towers, Houston, Tex., www.tsop.org
- **September 24–26, 2001:** Midwest/Great Lakes ArcInfo Users Group Conference, Hyatt Regency, Oak Brook, Ill., www.isgs.uiuc.edu/mwarc/
- **October 7–13, 2001:** Earth Science Week
- **November 5–8, 2001:** A Geo-Odyssey: GSA Annual Meeting, John B. Hynes Veterans Memorial Convention Center, Boston, Mass., www.geosociety.org/meetings/2001/
- **April 3–5, 2002:** Geological Society of America Southeastern–North-Central Section Meeting, Lexington, Ky., www.uky.edu/kgs/gsa2002/ ❖

KGS mailing list

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Field notes from across Kentucky

The power of the Internet

What do a geologist from Kentucky and an agronomist from Spain have in common? Plenty, it turns out. **Glynn Beck,** a geologist at the Henderson field office, has been doing research on high nitrate levels in water wells in the Jackson Purchase Region. A summary of his results is posted on the KGS Web site (www.uky.edu/kgs/water/research/agprotect.html). The agronomist came across Beck's results while surfing the Web. She is the quality manager at a garlic farm in Almeria, Spain, and has been having problems with high levels of nitrate in ground water there. She contacted Beck through the link provided on the Web site, and the two have been corresponding ever since. Beck is trying to help her determine how much nitrate is lost to plant uptake, gas, and leaching at the farm. Closer to home, Beck found that possible sources of nitrate in the Jackson Purchase are chemical fertilizers, leaky septic tanks, and active or abandoned feedlots, possibly in combination with leaky water wells.

Thanks to the Internet, the world has indeed become a small place! ❖

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